

## **Residual CRT Glass Management and the CEW Recycling Program**

### Purpose:

This issue paper proposes adjustments to regulations to allow for all legal ultimate disposition of residual cathode ray tube (CRT) glass derived from California's covered electronic waste (CEW) recycling program. The below discussion revisits assumptions, examines market realities, and assesses existing policies. It is marked as "draft" to indicate that it is not a formally adopted position of CalRecycle.

### Summary:

In 2001, when the Department of Toxic Substances Control (DTSC) clarified that CRT devices were in fact considered hazardous when disposed, recycling markets generally existed for recovered residual CRT glass. Although the cost of device recovery and processing typically exceeded the combined value of the glass and other residuals (resulting in a "net cost" to recycle this technology), there were readily available options to send CRT glass. To remain within the universal waste rule framework for hazardous electronic waste and CRT management, such markets were either new CRT manufacturing or lead smelting. While never a high-value commodity or an easy material to handle compliantly, properly sorted and cleaned residual CRT glass reportedly could be sold at that time for between \$100 and \$200 per ton to CRT manufacturers, and metal smelters would accept leaded glass at a nominal cost for use as a flux.

Today, over a dozen years later, new CRT devices are no longer being consumed in any appreciable amount in the developed world. In fact, it is unclear where and in what quantity new CRTs are being fabricated for assembly into video devices. Processed CRT glass from the West is being shipped to India at a significant costs reportedly ranging from \$100 and \$200 per ton. Reportedly only three large metal smelters in North America will accept leaded CRT glass, though their capacity and demand for CRT glass is limited. Long-promised new lead extraction technologies for high-lead content funnel glass are still being developed, with questions remaining about throughput and longevity.

A viable alternative large-scale application for low-leaded residual panel glass (which contains barium oxide for optical properties and radiation shielding) that conforms to California's stringent hazardous waste management rules continues to be elusive, with "recycling" options available in other states limited by environmental rules here.

For the past several years, California's CEW recycling program has generated approximately 100 million pounds of residual CRT glass annually, though volumes appear to be beginning to decline. A key component of the CEW recycling program has been a requirement that the derived residual CRTs and/or CRT glass be "shipped" to a destination authorized to further treat that material, under the assumption (and universal waste management requirement) that the material would eventually reach

an appropriate recycling application. With the use of intermediate facilities and foreign destinations, it is becoming increasingly difficult to ensure when, where, and whether residual CRT glass has achieved an appropriate disposition.

To address these issues, CalRecycle's CEW recycling program is proposing to amend existing regulation in a manner that would eliminate restrictions on the ultimate disposition of residual CRT glass beyond compliance with applicable rules for material management administered by DTSC. While proposing to eliminate restrictions on what becomes of residual CRT glass, the CEW program is also proposing to place limits on where certain dispositions may occur and timeframes within which certain ultimate disposition must occur.

#### Background:

Soon after the enactment of the Electronic Waste Recycling Act of 2003 (Act) via the passage of SB 20, CalRecycle's predecessor, the California Integrated Waste Management Board (CIWMB), proposed draft regulations to implement the CEW recovery and recycling payment system. The proposed regulations established claim eligibility requirements that included criteria for the management of treatment residuals derived from processed CEW. In order for a recycler to submit a payment claim for recycling CEW that contained CRTs, derived residual CRTs or CRT glass must have been shipped to a destination authorized to receive and further treat that material. In fact, for administrative documentation reasons, the initial proposed regulations based the recycling payment claim on the weight of the shipped glass multiplied by a payment rate factor that depended on the degree of residual glass processing.

SB 50 amended the Act in 2004, prior to the promulgation of the original proposed regulations, and required the CIWMB to pay on the full weight of CEW recovered and cancelled (see Public Resources Code (PRC), Section 42478(b)), establishing a clear distinction between CEW recycling and residual management, including residual CRT glass management. However, regulations continued to condition submittal of recycling payment claims on the shipment of residual CRT glass. During final rulemaking in November 2006, in part due to a 2006 market disruption involving a major lead smelter, regulations were clarified that all CRT glass derived from the processing (cancellation) of CEW must be shipped prior to submitting a recycling payment claim for that CEW.

There were several reasons for establishing residual CRT glass management criteria within the CEW recycling system rules. Residual CRTs and CRT glass, while no longer CEW, remain a regulated hazardous waste. While the ultimate disposition of the residual CRTs and CRT glass would occur in a timeframe and location far beyond the necessary scale of recycling claim cycles, this shipping requirement was deemed prudent to ensure that the CRT material was in fact moving toward a disposition allowable under California universal waste rules, the regulatory framework within which all program participants currently operate. Furthermore, the shipment of glass provided certified weight documentation that could act as an additional proxy measure for the original amount of CEW being claimed for recycling payment.

In addition to the CRT shipping criteria, CEW recycling claimants are also required by regulation to submit as part of a claim “... a discussion of the ultimate disposition of the (CRT) material shipped demonstrating that the disposition is not disposal to land, water or air” -- see California Code of Regulations (CCR), Title 14, Sections 18660.23(g)(4)(C) and 18660.24(g)(4)(C).

This requirement was again intended to be supportive of the foundational hazardous waste regulatory framework, specifically universal waste rules, under which material collection, transportation, and treatment typically occurred. To date, it must be noted that all “ultimate dispositions” have not “ultimately” been in California.

#### Program Experience:

Universal waste management rules applicable to residual CRT glass handling and treatment have generally recognized new CRT manufacturing and lead smelting as the only appropriate ultimate recycling dispositions for CRT glass. However, neither of these end-uses currently occurs within the state of California. Early program participants generally shipped glass to North American smelters or to glass processors for beneficiation prior to its subsequent marketing to overseas CRT manufacturers. As more volume of CEW was recovered and processed, a larger proportion of derived CRT glass was ostensibly sent toward the so-called “glass-to-glass” market (e.g., CRT manufacturing), either directly or through processors. This practice was influenced by accessibility and price, even as the global production and sale of CRT devices rapidly declined.

By mid-2009, approximately 75% of residual CRTs and/or CRT glass was being shipped to Mexican processors. However, in the 4<sup>th</sup> quarter of 2009, access to Mexican CRT glass processors was interrupted for nearly a year. Because CEW recyclers are required to ship CRT glass to a destination “authorized to receive and further treat” the glass prior to filing CEW recycling claims, this interruption caused the volume of claimed CEW to decrease dramatically while recyclers searched for alternative outlets for CRT glass. A couple of recyclers pursued establishing their own in-state CRT processing capabilities, while other enterprises started or offered capacities out-of-state.

The requirement to “ship” CRT glass has been interpreted by CalRecycle, as well as its predecessor (CIWMB), as meaning that the glass be moved off-site from the facility where the CEW was cancelled and the treatment residual generated. This interpretation has been supportive of universal waste accumulation time limits by discouraging onsite storage. As ready access to ultimate disposition options became more uncertain, and as the price charged by out-of-state processors increased, more recyclers pursued interest in establishing their own in-state, off-site processing capabilities (or at least authorizations) to fulfill treatment residual shipping criteria. While this would allow CEW recycling payment claims to be submitted with regularity, it did not create new end markets for CRT glass.

#### Current Situation:

CalRecycle understands that current markets for residual CRTs and CRT glass are limited. Access to traditional lead smelting is reportedly difficult, with only one facility in the U.S. (Doe Run, Missouri) and

two in Canada (Teck Cominco and Glencore (fka Xstrata)) known to accept CRT glass in volume. Furthermore, traditional smelting results in hazardous slag wastes that must be subsequently managed. There remains one known CRT manufacturer available to receive residual glass generated by California recyclers (Videocon Industries, located in India).

Access to Videocon is typically through an intermediate processor and/or broker, such as Glassico (aka TDA/TDM) located in Mexicali. However, given that the residual CRT glass derived from many states' recycling efforts are also competing for the same outlet, reliable access to and the longevity of this market for California recyclers is uncertain.

With the exception of Doe Run and Glencore (smelters) and Videocon Industries (the CRT manufacturer in India), all out-of-state destinations that received residual CRT shipments since 2013 are not ultimate endpoints; instead, they are considered intermediate facilities that ostensibly perform some degree of CRT processing before presumably shipping the glass onto a subsequent destination or ultimate disposition. One such operation, Dow Management in Yuma, AZ, unfortunately abandoned its "facilities" in June 2013, leaving behind in several warehouses substantial volumes of CRT in various stages of processing, including approximately 9 million pounds of CRT received from California recyclers. Most of the recyclers that shipped to Dow have since incurred considerable expense retrieving and redirecting the CRT for which they are legally responsible, though the effort to clear all the warehouses continues.

As of the drafting of this paper, approximately five California CEW recyclers are directly or indirectly affiliated with in-state operations authorized to further treat (e.g., break, cut, sort, separate, clean, etc.) residual CRT and/or CRT glass. These facilities are ostensibly authorized to treat CRTs under CCR, Title 22, Section 66273.73 and may accumulate CRTs and/or CRT glass for up to one year under universal waste rules before presumably shipping the CRTs and/or CRT glass onto another appropriate destination. Meanwhile, with the demise of Dow Management, all intact residual CRT shipped directly out-of-state within the past two years has been sent to either Closed Loop Refining & Recovery in Phoenix, AZ, or to Glassico in Mexicali.

#### Emergency CRT Management Regulations:

On October 15, 2012, DTSC issued emergency regulations governing the management of CRTs and CRT glass. These rules, readopted September 15, 2014, established stricter specificity on how in-state handlers are regulated depending on the ultimate disposition of this material. The rules preserve the ability of handlers who simply collect and dismantle CRT devices to operate under the universal waste framework. The rules also maintained pathways for CRTs and CRT glass to be shipped and ultimately recycled through traditional markets (smelting and CRT manufacturing) under the universal waste framework.

Perhaps the most significant changes in the rules created the allowance for CRTs and CRT glass to be ultimately managed via alternative recycling applications, if such applications exist, without necessarily jeopardizing the upstream handling and treatment of CRT devices and CRTs under the universal waste

concept. These changes also opened up the possibility of, and specified the standards for, regulated disposal for residual CRT glass should feasible markets be unavailable. (It must be noted again that the CEW recycling program regulations are separate from, though constructed with deference to, the rules that govern the physical management of residual CRTs and CRT glass.)

However, although now afforded the possibility of residual CRT disposal under DTSC's new CRT rules, the current CEW program rules require recyclers to "ship" residual CRTs and CRT glass for purposes other than disposal to land, air, or water. Unless and until that changes, CEW recyclers must continue to search for what appear to be elusive and diminishing residual CRT glass recycling options.

#### Looking Ahead for CRT Management:

CRT glass can be loosely categorized into leaded glass and non-leaded glass. Sometimes this is referred to as "funnel glass" and "panel glass" respectively, but such classification can be misleading since the panel glass of some CRTs also contains lead. And even so-called non-leaded glass contains other toxic metals, such as barium, at levels that create environmental and regulatory concern, particularly under current California hazardous waste law. The ability to effectively identify, separate, characterize, process, and test residual CRT glass will be critical to future management options.

New lead extraction technologies reportedly are emerging that may be more efficient than traditional smelting. Facilities in AZ, OH, TX, NY, and VA utilizing these new technologies are in differing stages of development but not in production-scale operation. Alternative applications also have been reported for non-leaded CRT glass, such as in building materials, tile, insulation, aggregate, proppant, industrial abrasives, reflective coatings, and fill. However CalRecycle is not aware of any alternative production-scale applications in the United States that have been demonstrated to and evaluated by DTSC and found to constitute an ultimate disposition that would warrant inclusion in the list of uses allowed under universal waste rules. Nor is CalRecycle aware of any proposed use for non-leaded CRT glass that has secured formal concurrence from DTSC as an excluded recyclable material.

As the CEW recycling system moves forward, consideration must be given to the availability of viable CRT glass markets and alternatives, the anticipated lifespan of those markets and the available supply of feedstock, and the environmental impacts associated with moving the glass to those markets versus other management options. Furthermore, while markets in far-off geographic areas may exist today, the economic ripples resulting from use of those markets should be a factor in any policy assessment. Does the fact that California recyclers pay to send CRT glass to certain downstream recipients artificially subsidize the continued consumption of hazardous inputs, prolonging the use of that material in products that will ultimately be disposed elsewhere, while potentially and simultaneously suppressing the development of local recycling infrastructure in certain destination countries?

The fact that the ultimate disposition of essentially all residual CRT glass currently occurs beyond California's borders, and in a timeframe that makes the effective monitoring of that disposition problematic, suggests policies that ensure more certain fates closer to home should be considered.

## Proposed Next Steps:

CalRecycle's CEW recycling program is proposing to amend existing regulation in a manner that would eliminate restrictions on the ultimate disposition of residual CRT glass beyond compliance with applicable rules for material management administered by DTSC.

Doing so would afford California recyclers the opportunity to explore the viability of all legal residual CRT disposition options available under the emergency regulations promulgated by DTSC, giving both the CEW recycling industry and regulators an opportunity to gain experience with such practices, should they be pursued. It would also create an alternative to an essentially monopolistic downstream market, which could better illuminate industry economics and reveal the actual costs and value associated with the management of this waste stream.

While proposing to eliminate restrictions on what becomes of residual CRT glass, the CEW program is also proposing to place limits on where certain dispositions may occur and timeframes within which certain ultimate disposition must occur. Additional demonstration of disposition will be required. Specifically, in the interest of maintaining direct access for California regulators to disposal sites that might receive processed panel glass, staff is proposing that any disposal of residual CRT glass derived from the CEW program be limited to Class II or Class III landfill units located in California. Additionally, staff is proposing that any residual CRT glass derived from the CEW program destined for disposal must be documented as having been legally disposed prior to the submittal of a payment claim for the originating CEW.

With the intent of limiting the possibility for indeterminate and speculative accumulation of CRT glass derived from the CEW program, it is also proposed that CalRecycle establish the obligation on CEW recycling claimants to be able to demonstrate, upon request and under penalty of forfeiture of any received recycling payment, that CRT and/or CRT glass shipped to an intermediate facility has reached its intended ultimate disposition within one year of initial shipment. Such demonstration would build upon the foundation of disposition documentation requirements established in DTSC's emergency regulations, specifically CCR, Title 22, Sections 66273.72(b)(4)(F) and 66273.75(f)(6).

While other, broader revisions to the current CEW program regulations are needed in the coming months, along with new regulations necessary to implement a civil liability facet to the program, this specific proposal focuses on amending only those sections that affect the disposition of residual CRT glass derived from CEW processing within the CEW recycling program, along with associated documentation requirements to demonstrate compliant dispositions. The amendments would be made under the emergency rulemaking authority granted by PRC, Section 42475.2.

For reference and discussion, an associated workshop attachment shows draft regulatory revisions via underline and ~~striketrough~~ in applicable sections of Title 14 of the California Code of Regulations.